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User Evaluation of the Utility of Twelve Decision Aids

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USER EVALUATION OF THE UTILITY OF TWELVE DECISION AIDS

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USER EVALUATION OF THE UTILITY OF TWELVE DECISION AIDS

Introduction

With the advance of computer technology, more decision aids are being used in the military environment. Various decision aids have been developed specifically to assist in communication and decision making processes for the military. Twelve such aids were demonstrated or utilized during a training exercise, Prairie Warrior 94, at Ft. Leavenworth, Kansas. This report documents the assessment of utility of these decision aid systems by student users and government and contractor evaluators. The assessment employed a generic user questionnaire developed to evaluate the utility of decision aids at various stages of development.

Description of Generic Utility Questionnaire

The questionnaire that was employed to assess utility was developed to be easily tailored to different aids and different development stages. The generic questionnaire was developed in four steps (Adelman, Gualtieri, & Riedel, 1993). First, the developers reviewed the literature to identify the different attributes of utility defined in the literature. Second, a Multi-Attribute Utility Assessment (MAUA) hierarchy (Figure 1) was devised for combining the individual usability attributes into broader utility concepts. Third, two or more questions were developed to measure each bottom-level attribute of the hierarchy. Last, the questionnaire was pilot-tested to determine its psychometric characteristics. The development and validation of the instrument is described in Adelman, Gualtieri, Riedel and Trent (1996).

The MAUA hierarchy depicts the nodes that make-up the utility of the decision aid. The top level nodes are system fit, system usability and effect on task performance. Each of these dimensions is then further divided into specific attributes (Adelman, et al., 1995).

System fit is the fit of the system with the organization and user. Attributes of system fit are how well the aid fits with the flow of information, with the user's needs, with problem solving, with doctrine and with others' work. System usability is subdivided into ease of training, general ease of use, workload, quality of user's mental model, human factors, flexibility and allocation of functions between the person and machine. Product and process quality are attributes of the effect on task performance node (Adelman, et al., 1995).

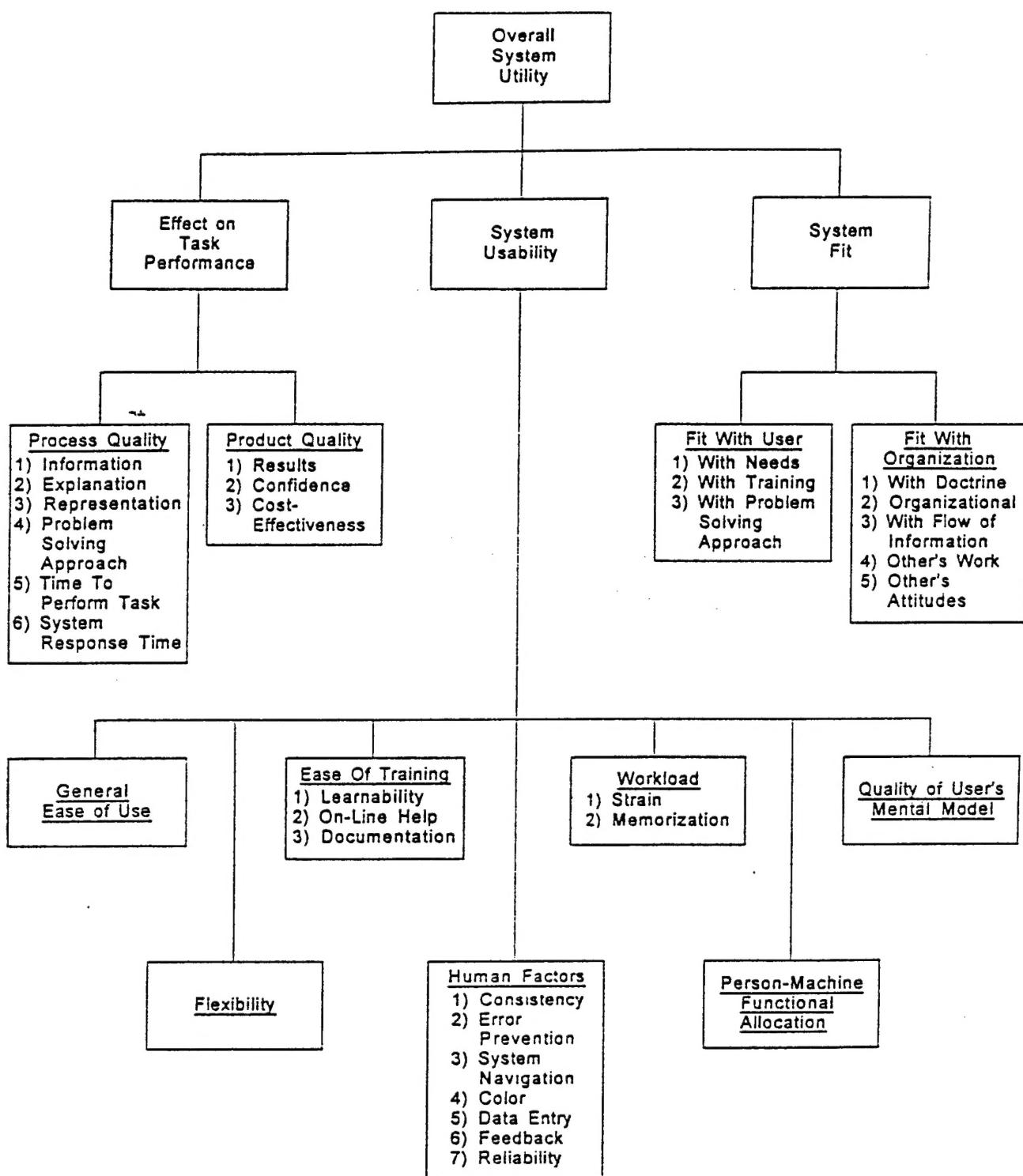


Figure 1. A MAUA Evaluation Hierarchy for Assessing Users' Opinions about System Utility.

Description of Decision Aid Systems

The functions of the decision aids varied from visualization of the battlefield to exchange of information to weather analysis. The aids that supported visualization of the battlefield are: Commander's Visualization Research Tool, Flying Carpet, Magic, Mission Planning Rehearsal System , and Multi-Spectral Capability. The Battle Command Decision Support System assisted with unit analysis, the weather was analyzed by the Integrated Weather Effects Decision Aid, MapInfo Desktop Mapping Decision Aid provided map overlays, avenues of approach were determined by the METT-T aid, and logistics were assessed by the KBLPS aid. Information exchange was aided by E-Note and Video Teleconferencing support systems.

Battle Command Decision Support System (BCDSS). This is a visual aid that displays unit status. Its intent is to provide the commander with a quick visual reference on unit status. The commander and staff are also provided with an interface for looking at facts and figures that support the visual displays. The system supports mission analysis, course of action (COA) development, COA analysis, decision and execution.

Commander's Visualization Research Tool (CoVRT). This aid was developed to support the commander and intelligence analyst. It provides a real time display of messages, graphics and imagery. The system is compatible with the Maneuver Control System (MCS) and supports a shared visualization of the battlefield between Brigade Commander and staff. It provides a real time display of messages, graphics and imagery, and assists in the development and dissemination of intelligence requirements. Incorporated within this system is a wide variety of graphics tools to facilitate overlay preparation.

Electronic Mail (E-NOTE). E-Note is an electronic mail system that is designed to facilitate the exchange of information and staff coordination. It allows both point-to-point and point-to-many distribution over local area and wide area networks (LANs and WANs). Briefing slides and documents can be attached to text messages. It supports COA development and mission execution tasks.

Flying Carpet. This is a terrain visualization tool for the commander and staff to assist in mission analysis, Intelligence Preparation of the Battlefield (IPB), wargaming and monitoring own forces. It provides the user with 3-D fly through visualization of the battlefield, 3-D view of the terrain from a specified vehicle, and realistic battle sounds. It has the capability to play out a battle given a mission and unit taskings.

Integrated Weather Effects Decision Aid (IWEDA). This system provides commanders, staff, and staff weather officers with weather effects information, including the impacts on missions, systems, subsystems and components. It also provides detailed explanations on why conditions are marginal or unfavorable, and enables the user to examine alternative mission set ups and weather conditions. Another feature is the provision of current and forecast weather for geographic area of interest.

Knowledge Based Logistic Planning System (KBLPS). This logistics planning tool was developed for use by the logistics officer (G4) and staff. It has the ability to compare requirements with log capabilities, has mapping capabilities, and calculates consumption of weapon systems over time. The system estimates Class III (fuels and lubricants) and V (ammunition) requirements given specified planning factors, and displays log inventory by echelon.

MAGIC. The purpose of MAGIC is to enable the commander to see the battlefield terrain and share a common view of the battlefield with the staff. The features include its ability to provide a real time, high resolution 3-D fly-drive through of terrain and display of moving vehicles. Additionally, the system has access to terrestrial and satellite communication networks, and aerial photography. It allows the user to control the view point and route, and supports mission planning, rehearsal, IPB, and execution.

MapInfo Desktop Mapping Decision Aid (MAPINFO). The system is a desktop mapping tool and decision aid which supports the display of maps and overlay graphics. It is a geographic information system (GIS) which can display Battle Command data by location. User data is displayed in the correct location with appropriate colors and symbols. The data may be viewed in text, map or graphic format. Data behind any object on a map may be queried and the distance between points calculated.

Mission, Enemy, Troops, Terrain and Time Available (METT-T). This system assists staff officers with the analysis of avenues of approach and determining the tactical effects of terrain and weather on combat operations. Additionally, it aids these officers in determining and developing task organizations and combat capabilities for both current and projected situations. It also assists with analyzing enemy capabilities and determining projected threat intent.

Mission Planning Rehearsal System (MPRS). Through terrain "computer visualization" of the battlefield, MPRS supports battle command. It also supports Terrain Analysis, IPB and other Intelligence Analysis functions. MPRS also sustains the tasks of mission analysis, COA development, COA analysis and comparison, decisions and execution.

Multi-Spectral Capability (MSI). This decision aid assists planners to perform terrain and intelligence analyses (including Intelligence Preparation of the Battlefield (IPB)) in support of mission analysis, COA development, and COA analysis and comparison. Two other features are an automated mapping aid to facilitate staff operations and the ability to produce maps using satellite imagery where maps or DMA data are not immediately available.

Space Enhanced Command and Control Capabilities (SPECC). This device supports automated worldwide unit location functions. Its features include: World wide automated unit locations, timing synchronization (Worldwide Atomic Clock), multimap display, worldwide asset tracking (GPS & Tracker), worldwide interconnectivity (Satellite Communications), Intelligence broadcast reception (National Asset Downlink), Situational awareness (red and blue force status), Operation Order (OPORD) generation and transmission, synchronization matrices, Unit-Log-Personnel and Status reports, joint forces Command and Control (C2) applicability, and other C2 activities. Its primary purpose is to aid staff members in performing mission analysis, IPB, and other intelligence functions, COA analysis and comparison, and execution tasks.

Video Teleconferencing (VTC). An aid designed to facilitate information exchange and staff coordination. VTC is a collaboration tool that allows two or more people, remotely located, to talk face-to-face in real-time. Staff members are aided in performing: Mission analysis, Intelligence Preparation of the Battlefield (IPB) and other intelligence functions, COA analysis and comparison, and execution tasks.

Method

Subjects

Twenty four Command and General Staff College students enrolled in a course testing command and control innovations and five government or contract employees serving as data collectors were asked to complete questionnaires addressing the utility of twelve decision support systems. This was accomplished after the students had participated in a week long exercise in which they used the aids. All data collectors and fourteen students completed at least one of the questionnaires.

Questionnaire

On the first page of each questionnaire was a description of the functions that were provided by the aid, directions for completing the form, a request for demographic data and questions asking for the number of hours of experience with the aid and the nature of the interaction with the aid (direct an operator, operate, observe).

For the evaluation described in this report, staff from the Battle Command Training Program (BCTP) at Fort Leavenworth, Kansas, selected the attributes from the Standard Utility hierarchy that fit each attribute they wanted evaluated. Appropriate questions were then selected and a questionnaire was specifically tailored for each decision aid. For this section of the questionnaire, a 7-point Likert scale was used to indicate degree of agreement with the statement. Due to a stipulation by BCTP, the students' questionnaires were composed of fewer questions than the ones for the data collectors. Questionnaires for the different aids varied in length because of differences in type and stage of development of the aid. Example questionnaires for the two groups are in Appendices B and C.

A second section, which differed in length and complexity for students and data collectors, required an assessment of the capabilities, advantages and disadvantages of the aid. One part of this section asked the respondents (students and data collectors) to signify, using a 5-point Likert scale, the extent that the aid would improve battle planning and execution, mission analysis, intelligence preparation of the battlefield (IPB), course of action development, course of action analysis and comparison, the commander's decision and execution. Questionnaires for the data collectors also included a rating of how much the capabilities of each aid would increase situational awareness, facilitate a shared understanding of the battlefield, assist in the synchronization of tactical operations and facilitate plan rehearsal. The data collectors were asked to rate (1) how much the tested aid capabilities could potentially improve performance and (2) how much the aid actually improved

performance. Additional questions requested which capabilities should be eliminated or added, advantages and disadvantages of the aid, and flexibility of the aid to perform different tasks. All questionnaires were similar in design and focused on the utility of the systems in the military environment. One question, addressing the extent to which the aid could replace paper map functions in the tasks of planning, analysis, execution, and command and control, was included for MPRS and MSI. Finally, students and data collectors were encouraged to provide comments on any aspect of the aid.

All aids were not rated by all of the students or data collectors. The reasons for this are: 1) the aid was not functional (KBPLS), 2) the aid did not fit into what the student was doing, 3) the rater only observed the use of the aid and did not feel comfortable evaluating it. In some instances only one student or data collector responded to the questionnaire and all ratings should be viewed with this in mind. Of the students, one student rated CoVRT, Flying Carpet, Magic and METT-T; and of the data collectors one data collector rated IWEDA, Magic, METT-T and MSI.

RESULTS

The utility of each of the aids was evaluated by students and data collectors. The tables that follow display the means, standard deviations and range for each attribute in the utility hierarchy. A synopsis of the comments related to each aid are included before each table. The overall utility in the tables is based on questions of overall utility and is not based on an integration of the subattribute scores.

The ratings are based on responses to questions employing a 7 point Likert scale, where 1 means the system has a very negative effect, 4 means the system is neither negative nor positive and 7 that the system is rated very positively. The mean, over all respondents, for overall utility was greater than one for all aids, suggesting all aids were seen as having some utility.

Battle Command Decision Support System (BCDSS)

The purpose of this aid is to provide a visual representation of the unit status for the Commanders and Staff Officers. Two students observed the aid as it was being used, and the others operated the aid. An examination of the following table (See Table 1) for student assessment of utility indicates that the mean for overall utility was 4.95 with little variability among the students' ratings. All data collectors observed the operation of the decision aid. The ratings (See Table 2) of the data collectors for this overall utility resulted in a mean of 5.30, again with little variability. This indicates that, for the most part, the two groups believed that the aid had some utility.

As reflected in Table 1 and 2, the students' and data collectors' evaluation of the quality of the results demonstrated confidence in the results with little variability of their opinions. The ease of use, human factors and flexibility of the aid received the highest ratings by the students. However, the data collectors rated human factors lowest of the three dimensions.

The most variability and consistently lowest ratings of the students were found with those questions addressing the system fit with the organization and user. System fit refers to the degree to which the characteristics of the system correspond with the needs of the users and their organization. It is considered to be a measure of how much the system will be utilized. This variability was not found for the data collectors who, as a group, rated these characteristics higher than the students' ratings.

Table 1

Student Utility Scores for BCDSS

	Node 0.0 Overall Utility	Node 1.0 System Quality	Node 1.1 Quality of Results	Node 1.2 Quality of Problem Solving	Node 2.0 Ease of Use	Node 2.4 Human Factors for Person-Machine Interaction	Node 2.6 ^a Flexibility	Node 3.0 System Fit	Node 3.1 Fit with User	Node 3.2 Fit with Organization
N	10	9	8	8	9	8	7	10	10	8
Mean	4.95	4.93	5.34	4.44	5.40	5.28	5.43	4.54	4.53	4.63
SD	0.88	0.87	0.95	1.15	0.92	1.06	0.98	1.44	1.40	1.72

Table 2

Data Collector Utility Scores for BCDSS

	Node 0.0 Overall Utility	Node 1.0 System Quality	Node 1.1 Quality of Results	Node 1.2 Quality of Problem Solving	Node 2.0 Ease of Use	Node 2.4 Human Factors for Person-Machine Interaction	Node 2.6 Flexibility	Node 3.0 System Fit	Node 3.1 Fit with User	Node 3.2 Fit with Organization
N	3	3	3	3	3	3	3	3	3	3
Mean	5.30	5.47	5.11	5.83	5.07	4.89	5.33	5.35	5.00	5.71
SD	0.36	0.50	0.42	0.80	0.33	0.26	0.29	0.63	1.00	0.59

Differences in the results of the ratings for the two groups can be accounted for by the difference in the number of students (7-10) and data collectors (3) responding to the questionnaire. There was consistently less variability among the ratings for the data collectors than the students. Another reason is that the data collectors could have initially been more familiar with the aid, or entered the evaluation process with biases toward the aid. Additionally, the data collectors were not operating the aid as a device for gaining information for the exercise but rather observing use of its capabilities. Six respondents commented that automated data update was needed if BCDSS was to be useful.

Although the ratings were above the midpoint for all of the characteristics assessed, students and data collectors had several negative comments concerning the aid. Many raters from each group remarked that the aid was slow, cumbersome at times, increased user workload, and was too difficult to maintain.

Commander's Visualization Research Tool (CoVRT)

This aid supports a shared visualization of the battlefield between the brigade commander and staff and provides a real time display of messages, graphics, and imagery. Five students returned questionnaires, but only one student evaluated the aid (See Table 3). Another student said he only it. Three other students who returned questionnaires indicated CoVRT was unavailable or they had not used or observed it. As noted in the table below, the one student who evaluated CoVRT rated all attributes addressed on the questionnaire above the midpoint marker without commenting on any areas.

The mean rating for overall utility for three data collectors (See Table 4) was 3.76. This is in the marginal range of performance range of the utility scale. Data collectors rated CoVRT as difficult to use giving the system unfavorable ratings for ease of use, Human factors and flexibility. The highest mean ratings were for the quality of problem solving and system quality, with both scoring just above 4.

The difference in the number of data collectors and students who evaluated this aid make it difficult to compare and contrast the ratings of each group. The student rater did not express any displeasure with the aid. One data collector commented that in general CoVRT would require a great deal of training. In addition, use of the raw imagery data the system provided would require the assistance of an imagery analyst.

E-NOTE

E-Note is an electronic mail system that is designed to

Table 3

Student Utility Scores for CoVRT

	Node 0.0 Overall Utility	Node 1.0 System Quality	Node 1.1 Quality of Results	Node 1.2 Quality of Problem Solving	Node 2.0 Ease of Use	Node 2.4 Human Factors for Person-Machine Interaction	Node 2.6 Flexibility	Node 3.0 System Fit	Node 3.1 Fit with User	Node 3.2 Fit with Organization
N	1	1	1	1	1	1	1	1	1	0
Mean	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	NA
SD	.	.	.	.	.	.	.	.	.	.

Table 4

Data collector Utility Scores for CoVRT

	Node 0.0 Overall Utility	Node 1.0 System Quality	Node 1.1 Quality of Results	Node 1.2 Quality of Problem Solving	Node 2.0 Ease of Use	Node 2.4 Human Factors for Person-Machine Interaction	Node 2.6 Flexibility	Node 3.0 System Fit	Node 3.1 Fit with User	Node 3.2 Fit with Organization
N	3	3	3	3	3	3	2	3	3	3
Mean	3.76	4.13	3.84	4.42	3.28	3.44	3.25	3.88	3.67	4.08
SD	0.77	0.63	0.45	0.80	0.86	1.44	1.06	0.87	1.53	0.58

Table 5
Student Utility Scores for E-NOTE

	Node 0.0	Node 1.0	Node 1.1	Node 1.2	Node 2.0	Node 2.4	Node 2.6	Node 3.0	Node 3.1	Node 3.2
Overall Utility	System Quality	Quality of Results	Quality of Problem Solving	Ease of Use	Human Factors for Person-Machine Interaction	Flexibility	System Fit	Fit with User	Fit with Organization	
N	12	12	12	12	11	11	11	12	12	12
Mean	4.85	5.25	5.38	5.13	4.55	4.09	4.68	4.65	4.29	5.01
SD	1.24	1.39	1.52	1.48	1.65	1.86	1.95	1.35	1.87	1.51

Table 6
Data Collector Utility Scores for E-NOTE

	Node 0.0	Node 1.0	Node 1.1	Node 1.2	Node 2.0	Node 2.4	Node 2.6	Node 3.0	Node 3.1	Node 3.2
Overall Utility	System Quality	Quality of Results	Quality of Problem Solving	Ease of Use	Human Factors for Person-Machine Interaction	Flexibility	System Fit	Fit with User	Fit with Organization	
N	5	5	5	5	5	4	5	5	5	5
Mean	5.23	5.83	5.47	6.20	4.67	4.40	5.00	5.24	5.20	5.28
SD	1.02	0.91	0.69	1.30	1.42	1.26	1.68	1.21	2.17	0.58

facilitate the exchange of information and staff coordination. It supports COA development and mission execution tasks. E-Note was one of the most used of the fourteen decision aids examined in Prairie Warrior; twelve students reported they had used E-Note in the exercise. It generally scored well on the questionnaire although respondents had many suggestions for improvement. An examination of their ratings (See Table 5) indicated that the highest mean ratings were for quality of the results, system quality and quality of problem solving. The mean ratings of these were all above 5, indicating users' perceived E-Note as useful. However, they rated ease of use and system fit with the user and organizations as marginal.

Data collectors' ratings were higher than the students' ratings for all the attributes. They also rated E-Note as marginal on ease of use.

Students and data collectors had many comments about the disadvantages of the system and suggestions for improvement. Two students noted that this aid increases the workload of the staff because "the time it takes to type, retrieve, move notes around, etc, is all wasted time", and lacks "a protocol that will establish files and help route info". Other comments addressed an interruption to work and other functions because the notes "pop up into the middle of the work". Difficulty was also indicated in the facilitation of the flow of information during planning and execution. One student felt that this system would assist in this area if "some one is dedicated to monitoring the system and bringing important messages to the attention of the commander, etc."

The primary focus of the data collectors' comments indicated a lack of functionality of the system because of a need for "better logical icons", a militarized version, and a "fully functional e-mail system". There were also comments that the system was rudimentary and needed "a more sophisticated and user friendly capability for it to be a true asset and meet user acceptability".

Flying Carpet

This is a terrain visualization tool which provides a 3-D visualization of the battlefield, terrestrial and satellite communication networks, and aerial photography. This decision aid was not available to the group for use, but was demonstrated. One student and two data collectors responded to the questionnaire, and the results are shown in Tables 7 and 8. Overall, data collectors rated Flying Carpet as marginal in overall quality with ease of use as marginal or deficient. The student who rated this system thought it had marginal to good overall quality but deficient in its fit with organization needs.

Table 7

Student Utility Scores for FLYING CARPET

	Node 0.0 Overall Utility	Node 1.0 System Quality	Node 1.1 Quality of Results	Node 1.2 Quality of Problem Solving	Node 2.0 Ease of Use	Node 2.4 Human Factors for Person-Machine Interaction	Node 2.6 Flexibility	Node 3.0 System Fit	Node 3.1 Fit with User	Node 3.2 Fit with Organization
N	1	1	0	1	0	0	0	1	1	1
Mean	5.00	4.00	.	4.00	.	.	.	4.25	5.50	3.00
SD	.	.	.	.	.	.	.	.	.	.

Table 8

Data Collector Utility Scores for FLYING CARPET

	Node 0.0 Overall Utility	Node 1.0 System Quality	Node 1.1 Quality of Results	Node 1.2 Quality of Problem Solving	Node 2.0 Ease of Use	Node 2.4 Human Factors for Person-Machine Interaction	Node 2.6 Flexibility	Node 3.0 System Fit	Node 3.1 Fit with User	Node 3.2 Fit with Organization
N	2	2	2	2	2	2	1	2	2	2
Mean	4.23	4.55	3.97	5.13	3.56	3.67	3.50	4.00	3.50	4.49
SD	0.75	0.36	0.90	0.18	1.10	1.18	3.50	4.00	3.50	4.91

Comments made by the data collectors indicated that the aid needed to be more user friendly, it is physically too large to fit into the operations of the staff, and it needs some enhancements for the user to have confidence in its approach to planning. Great visualization of the commander's battle space was viewed as an advantage. The student stated that the aid was more like a toy than a tool.

IWEDA

This system provides commanders, staff, and staff weather officers with weather effects information, and detailed explanations on why conditions are unfavorable for the missions and systems. The four students who completed this questionnaire gave the highest ratings (See Table 9) to fit with the organization, quality of results, system quality, and the overall utility rating. Although, students rated system fit and fit with organization above 5 points, their rating of fit with user (4.75) was slightly lower. Among these ratings, fit with organization had the least variability, .76. The lowest rating (3.5) was given to flexibility of the system, which also had the most variability (2.12). One data collector rated (See Table 10) this aid, rating most of the dimensions at around 5. The students commented that IWEDA did not tell much more than could be gotten from the staff weather officer (SWO), it was not worth the space that would be taken up in the TOC, and the system needs too much user input. Additionally, "IWEDA is a system that tells a commander the effects of Wx (weather) on his personnel and weapon systems". One student said this was a no-brainer for a "competent commander." Although receiving fairly consistent midpoint ratings, these remarks indicate that this aid was not considered to have much utility for the staff. Suggested improvements included automated weather data entry, effects on enemy systems, and links to other army systems.

Some comments reflected positive attributes of the aid. The shift between the big picture and specifics was good, and it has good forecast options. One student wrote that the device needs to address three things: 1) current weather, 2) the forecast, 3) effects on enemy weapon systems. However, another stated that the aid was not user friendly, and a large screen was needed.

KBLPS

Was not operational.

Table 9

Student Utility Scores for IWEDA

	Node 0.0	Node 1.0	Node 1.1	Node 1.2	Node 2.0	Node 2.4	Node 2.6	Node 3.0	Node 3.1	Node 3.2
	Overall Utility	System Quality	Quality of Results	Quality of Problem Solving	Ease of Use	Human Factors for Person-Machine Interaction	Flexibility	System Fit	Fit with User	Fit with Organization
N	4	4	4	4	3	3	2	4	4	3
Mean	5.13	5.19	5.50	4.88	4.00	4.00	3.50	5.44	4.75	5.83
SD	1.35	1.21	1.00	1.44	1.73	1.73	2.12	1.34	1.85	0.76

Table 10

Data Collector Utility Scores for IWEDA

	Node 0.0	Node 1.0	Node 1.1	Node 1.2	Node 2.0	Node 2.4	Node 2.6	Node 3.0	Node 3.1	Node 3.2
	Overall Utility	System Quality	Quality of Results	Quality of Problem Solving	Ease of Use	Human Factors for Person-Machine Interaction	Flexibility	System Fit	Fit with User	Fit with Organization
N	1	1	1	1	1	1	0	1	1	1
Mean	4.98	4.93	5.20	4.67	5.00	5.00	.	5.00	5.00	5.00
SD	.	.	.	.	.	.	.	.	.	.

MAGIC

MAGIC allows the commander to view the battlefield terrain and to share a common view of the battlefield with his staff. One student and no data collectors responded to the questionnaire. The student's ratings are listed in Table 11. Overall the student rated this system as having a great deal of utility. He did not rate the ease of use of the system. Comments that were made were generally positive. Comments include that it is "potentially good for terrain", and provides useful information to the commander, but that the lag times for response to user's commands were too long to create the views. Because only one student responded to the questionnaire, the results do not provide a useful appraisal of the utility of the aid.

MAPINFO

This aid supports the display of maps and overlay graphics. Twelve students and all of the data collectors responded to this questionnaire. Map Info was the only system that was used by all the students. It also received their lowest ratings of all the aids on overall utility, system quality and system fit with the user. Conversely the ratings (See Table 13) of the data collectors were above the midpoint for all dimensions. As with the students, usability was rated as marginal, but MAPINFO was rated as having utility in terms of quality of the system and system fit.

Comments of the students ranged from "lots of potential" but needs "fixes" concerning planning and execution performance to indications that the speed was slow and cumbersome. Additionally, four of the students reported that the aid would increase the workload. One student commented that he was "never less than frustrated with MapInfo" and another that the aid needs "lots of fixes" and a third "to get rid of MapInfo".

The data collectors comments included that the aid had poor functionality, it was dependent on the source of data, and the user needed the FM (field manual) on operational graphics. Additionally, it was not viewed as being easy to use and required too many keystrokes.

Suggestions for improvement included maps with additional graphics, standard map scales and special terrain data like obstacles; a better user interface, and links to systems like ASAS for enemy templates and MSI for satellite data.

Table 11

Student Utility Scores for MAGIC

	Node 0.0	Node 1.0	Node 1.1	Node 1.2	Node 2.0	Node 2.4	Node 2.6	Node 3.0	Node 3.1	Node 3.2
Overall Utility	System Quality	Quality of Results	Quality of Problem Solving	Ease of Use	Human Factors for Person-Machine Interaction	Flexibility	System Fit	Fit with User	Fit with Organization	
N	1	1	1	1	0	0	0	1	1	0
Mean	6.00	4.00	4.00	4.00	.	.	.	6.00	6.00	.
SD	.	.	.	.	.	.	.	.	.	.

Table 12

Student Utility Scores for MAPINFO

	Node 0.0	Node 1.0	Node 1.1	Node 1.2	Node 2.0	Node 2.4	Node 2.6	Node 3.0	Node 3.1	Node 3.2
	Overall Utility	System Quality	Quality of Results	Quality of Problem Solving	Ease of Use	Human Factors for Person-Machine Interaction	Flexibility	System Fit	Fit with User	Fit with Organization
N	12	12	12	12	12	12	12	12	12	12
Mean	3.72	3.19	3.18	3.20	4.35	4.04	4.67	3.63	3.52	3.74
SD	1.73	1.94	2.00	1.97	1.94	1.82	2.15	1.84	1.87	1.92

Table 13

Data Collector Utility Scores for MAPINFO

	Node 0.0	Node 1.0	Node 1.1	Node 1.2	Node 2.0	Node 2.4	Node 2.6	Node 3.0	Node 3.1	Node 3.2
	Overall Utility	System Quality	Quality of Results	Quality of Problem Solving	Ease of Use	Human Factors for Person-Machine Interaction	Flexibility	System Fit	Fit with User	Fit with Organization
N	5	5	5	5	5	5	4	5	5	5
Mean	5.72	3.78	3.65	3.91	4.71	4.80	4.75	5.19	5.20	5.18
SD	1.07	1.08	0.93	1.29	1.15	0.88	2.50	1.11	0.91	1.33

METT-T (Mission, Enemy, Troops, Terrain-Time Available)

This system assists staff officers with the analysis of avenues of approach and in determining the tactical effects of terrain and weather on combat operations. One student and one data collector responded to the questionnaire. The results are presented in Tables 14 and 15. The one student who did rate the aid had observed a demonstration of its use. He commented that it did not appear to be user friendly, and that he was not able to make comments on other aspects of this device unless he could use it.

The data collector rated the system as having very good interface. He thought the concept for METT-T was good but that the system had marginal utility at this time.

Mission Planning Rehearsal System (MPRS)

MPRS is a decision aid that supports Battle Command through terrain "computer visualization" of the battlefield. The six students who rated this device had observed its use. Their ratings (See Table 16) were consistently above the midpoint for all dimensions with the quality of problem solving rated as very good.

Three of the five data collectors completed the questionnaire (See Table 17). The highest rating was also given to the quality of problem solving of the device (5.42). Both students and data collectors felt the system was too slow. Their ratings on all dimensions of the aid were consistently lower than those given by the students. Several commented that better terrain resolution was needed, that the system should be made more user friendly, and that the complex Unix system would require a great deal of user training.

Multi-Spectral Capability (MSI)

This decision aid provides terrain visualization and assists planners to perform terrain and other intelligence analyses. Eight students and one data collector responded to this questionnaire. The students rated (See Table 18) the quality of problem solving and fit with the organization as good and the usability factors as marginal.

One student felt the aid had potential because it offered "other perspectives that are useful", and another commented that it is useful because it brings mapping capabilities into unmapped parts of the world. Other respondents felt the aid needed better resolution, operational graphics, a ATM grid overlay, a better interface and to be linked to other systems.

Table 14

Students Utility Scores for METT-T

	Node 0.0	Node 1.0	Node 1.1	Node 1.2	Node 2.0	Node 2.4	Node 2.6	Node 3.0	Node 3.1	Node 3.2
	Overall Utility	System Quality	Quality of Results	Quality of Problem Solving	Ease of Use	Human Factors for Person-Machine Interaction	Flexibility	System Fit	Fit with User	Fit with Organization
N	1	1	1	0	1	1	1	1	1	1
Mean	4.50	5.50	5.50	.	3.00	4.00	2.00	5.00	5.00	5.00
SD	.	.	.	.	.	.	.	.	.	.

Table 15

Data Collector Utility Scores for METT-T

	Node 0.0	Node 1.0	Node 1.1	Node 1.2	Node 2.0	Node 2.4	Node 2.6	Node 3.0	Node 3.1	Node 3.2
	Overall Utility	System Quality	Quality of Results	Quality of Problem Solving	Ease of Use	Human Factors for Person-Machine Interaction	Flexibility	System Fit	Fit with User	Fit with Organization
N	1	1	1	1	1	1	0	1	1	1
Mean	4.92	4.75	4.75	4.75	6.00	6.00	.	4.50	4.00	5.00
SD	.	.	.	.	.	.	.	.	.	.

Table 16
Student Utility Scores for MPRS

	Node 0.0	Node 1.0	Node 1.1	Node 1.2	Node 2.0	Node 2.4	Node 2.6	Node 3.0	Node 3.1	Node 3.2
	Overall Utility	System Quality	Quality of Results	Quality of Problem Solving	Ease of Use	Human Factors for Person-Machine Interaction	Flexibility	System Fit	Fit with User	Fit with Organization
N	6	6	6	6	6	6	5	6	6	6
Mean	4.84	5.06	4.67	5.46	4.60	4.79	4.30	4.86	4.92	4.80
SD	0.47	0.68	0.61	0.81	0.39	0.56	0.46	0.72	0.80	0.78

Table 17

Data Collector Utility Scores for MPRS

	Node 0.0	Node 1.0	Node 1.1	Node 1.2	Node 2.0	Node 2.4	Node 2.6	Node 3.0	Node 3.1	Node 3.2
	Overall Utility	System Quality	Quality of Results	Quality of Problem Solving	Ease of Use	Human Factors for Person-Machine Interaction	Flexibility	System Fit	Fit with User	Fit with Organization
N	3	3	3	3	3	3	2	3	2	3
Mean	4.30	4.64	3.87	5.42	3.33	3.67	3.00	4.41	4.00	4.58
SD	0.33	0.40	0.23	0.58	0.58	0.34	1.41	0.46	1.41	0.20

Table 18

Student Utility Scores for MSI

	Node 0.0 Overall Utility	Node 1.0 System Quality	Node 1.1 Quality of Results	Node 1.2 Quality of Problem Solving	Node 2.0 Ease of Use	Node 2.4 Human Factors for Person-Machine Interaction	Node 2.6 Flexibility	Node 3.0 System Fit	Node 3.1 Fit with User	Node 3.2 Fit with Organization
N	8	8	8	8	5	5	4	8	8	8
Mean	5.01	5.13	4.94	5.31	4.60	4.70	4.63	5.14	5.06	5.23
SD	0.55	0.67	0.62	0.75	0.65	0.84	0.95	0.57	0.78	0.55

Table 19

Data Collector Utility Scores for MSI

	Node 0.0 Overall Utility	Node 1.0 System Quality	Node 1.1 Quality of Results	Node 1.2 Quality of Problem Solving	Node 2.0 Ease of Use	Node 2.4 Human Factors for Person-Machine Interaction	Node 2.6 Flexibility	Node 3.0 System Fit	Node 3.1 Fit with User	Node 3.2 Fit with Organization
N	2	2	2	2	2	2	2	2	2	2
Mean	3.84	4.50	4.00	5.00	3.27	2.80	3.75	3.47	2.50	4.44
SD	0.27	0.41	0.47	0.35	1.36	1.31	1.78	0.13	0.00	0.26

Space Enhanced Command and Control Capabilities (SPECC)

This device supports automated worldwide unit location functions. Twelve students and three data collectors rated this aid; of these, four students had used the aid. The students rated (See Table 20) the quality of results and system fit as good, and usability as marginal.

The three data collectors rated system quality, system fit flexibility, and usability as good. Quality of problem solving, a subattribute of system quality, was rated very good by the data collectors. Of interest is the difference in ratings for flexibility between the students and data collectors. The students viewed this aid has having less flexibility than did the data collectors.

As reflected in their comments, the students felt that this aid was "slow to build operational graphics, not user friendly and needed better map resolution. One data collector expressed concern, in several instances, about the amount of user training that the aid would require. This person also felt that the aid was not user friendly, although it did have a "good graphic map picture". Other suggestions for improvement include interconnectivity with satellite communications and ASAS, and that capabilities such as unit status display, task organization, and sync matrices be added.

Video Teleconferencing (VTC)

VTC is a collaboration tool that allows two or more people, remotely located, to talk face-to-face in real-time. Ten students and three data collectors rated this aid. VTC received the highest ratings of any of the aids across all of the rating dimensions. The students and data collectors viewed (See Table 22 and 23) the quality of problem solving, system quality and fit with the organization as good to very good. Usability dimensions were rated somewhat lower but still in the good range.

The students' comments indicated that this aid would not replace face-to-face communication, will increase work load for some, and needs to be able to conference VTC with about 8-12 participants. Students also thought a direct feed of computer maps and graphics would aid the resolution of these pictures. An advantage was seen in that the aid required little training. Student recommendations were to incorporate an integrated fax to out stations and to have miniature systems between Army posts. The data collectors also found that users of the aid needed little training, that the capabilities were diverse and could augment face-to-face communication. Disadvantages were noted in the resolution of the picture, it needed to be more user friendly.

Table 20

Student Utility Scores for SPECCC

	Node 0.0	Node 1.0	Node 1.1	Node 1.2	Node 2.0	Node 2.4	Node 2.6 ^a	Node 3.0	Node 3.1	Node 3.2
	Overall Utility	System Quality	Quality of Results	Quality of Problem Solving	Ease of Use	Human Factors for Person-Machine Interaction	Flexibility	System Fit	Fit with User	Fit with Organization
N	12	12	12	12	9	9	9	12	12	12
Mean	4.78	4.93	5.08	4.77	4.18	4.31	4.05	4.90	4.88	4.93
SD	0.99	1.42	1.44	1.50	1.24	1.29	1.63	0.89	1.25	0.68

Table 21

Data Collector Utility Scores for SPECCC

	Node 0.0	Node 1.0	Node 1.1	Node 1.2	Node 2.0	Node 2.4	Node 2.6	Node 3.0	Node 3.1	Node 3.2
	Overall Utility	System Quality	Quality of Results	Quality of Problem Solving	Ease of Use	Human Factors for Person-Machine Interaction	Flexibility	System Fit	Fit with User	Fit with Organization
N	3	3	3	3	3	3	2	3	3	3
Mean	5.15	5.32	4.81	5.83	4.91	4.83	5.00	5.21	4.83	5.58
SD	0.95	0.96	1.04	1.01	0.98	2.17	1.41	1.12	1.76	0.75

Table 22

Student Utility Scores for VTC

	Node 0.0	Node 1.0	Node 1.1	Node 1.2	Node 2.0	Node 2.4	Node 2.6	Node 3.0	Node 3.1	Node 3.2
Overall Utility	System Quality	Quality of Results	Quality of Problem Solving	Ease of Use	Human Factors for Person-Machine Interaction	Flexibility	System Fit	Fit with User	Fit with Organization	
N	11	11	0	11	9	9	0	11	9	11
Mean	5.27	5.46	.	5.46	5.11	5.11	.	5.16	4.56	5.59
SD	1.06	1.23	.	1.13	1.69	1.69	.	1.23	1.42	1.11

Table 23

Data Collector Utility Scores for VTC

	Node 0.0	Node 1.0	Node 1.1	Node 1.2	Node 2.0	Node 2.4	Node 2.6	Node 3.0	Node 3.1	Node 3.2
Overall Utility	System Quality	Quality of Results	Quality of Problem Solving	Ease of Use	Human Factors for Person-Machine Interaction	Flexibility	System Fit	Fit with User	Fit with Organization	
N	3	3	3	3	3	3	2	3	3	3
Mean	5.15	5.32	4.81	5.83	4.91	4.83	5.00	5.21	4.83	5.58
SD	0.95	0.96	1.04	1.01	0.98	1.09	1.41	1.12	1.76	0.75

Discussion

Overall, the highest ratings were given to the aids that assisted in communications. Eleven students rated VTC highest on all but the dimensions of flexibility and quality of results. VTC was viewed more positively across all the rated dimensions than any other aid. One reason for this is that video teleconferencing is familiar to the officers because it is already in use. Added to this is video teleconferencing is considered to be user friendly. There was little difference between the data collectors and student ratings for this aid.

The results of this study show there is a need for the capabilities represented in the evaluated aids. Video teleconferencing, map displays, creating and showing operational graphics, unit status display and update, automated terrain analysis--these and more have the potential to improve tactical planning and operations.

However, many improvements are needed before the aids will realize that potential. One of the most frequently mentioned problems with the aids was that they were not user friendly. Even if an aid has great capabilities, a bad soldier machine interface (SMI) will discourage its use, increase training requirements, increase errors, and in general degrade any performance improvement it might make. The SMI is so important its design should be addressed at the beginning of development.

One suggestion that was made for almost all of the aids was that input of updated data should be automated. It is very time intensive to manually enter data. In a time crunch it won't be and the systems won't be used.

Finally, another frequently mentioned suggestion is that the aids should be interconnected. To manually input the results from one aid into another is time consuming and unnecessary effort.

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APPENDIX A
UTILITY HIERARCHY AND QUESTIONS

Standardized Questions

Note: The information within brackets [] indicates how the evaluator needs to tailor the question.

0.0 Overall System Utility

10. I think an operational version of the [System Name] is good enough to use in a major training exercise.
24. The [System Name] is a valuable tool for [purpose of system].
33. Overall, the [System Name] is a useful approach for [purpose of system].
51. Use of the [System Name] will improve [purpose of system] performance.
61. I recommend continued development of the [System Name] for operational use.
86. Overall, the [System Name] improves [purpose of system].

1.0 Effect on Task Performance

1.1 Process Quality

1.1.1 Quality of the Information (Data & Knowledge)

14. The [System Name] is using the right data for [purpose of system].
36. I agree with the [use the word "knowledge" or identify a type of knowledge stored in the knowledge base] stored in the [System Name] for [purpose of system].
44. I agree with the [identify a second type of knowledge stored in the knowledge base] stored in the [System Name] for [purpose of system].

Note: If the above version of question #44 is inappropriate because one can not easily distinguish between the different types of knowledge stored in the knowledge base, use the following version of question #44.

44. The [System Name] contains the right knowledge for [purpose of system].

65. I agree with the [identify a third type of knowledge stored in the knowledge base] stored in the [System Name] for [purpose of system].

Note: If the above version of question #65 is inappropriate because one can not easily distinguish between the different types of knowledge stored in the knowledge base, use the following version of question #65.

65. The [System Name] contains an adequate level of expertise to support users performing [purpose of system].

83. The [System Name] uses the correct information in producing its results.

1.1.2 Quality of the Explanation Capability/Reasons

19. Overall, the reasoning underlying the results is acceptable.

49. The [System Name] provided good reasons for its results.

90. It is easy to interpret the results of the [System Name].

1.1.3 Quality of the Representation, Examination, and Modification of Knowledge Stored in System

32. In general, it is easy to modify the knowledge stored in the [System Name].

82. The [System Name] allows users to examine the expert judgments on which the system's recommendation is based.

1.1.4 Quality of the Problem Solving Approach

11. The [System Name's] approach to representing expert knowledge for [purpose of system] is acceptable.

42. The [System Name] uses a logically sound approach for [purpose of system].

58. The [System Name's] approach to [purpose of system] is acceptable.

85. The calculations [or analysis] performed by the [System Name] were helpful.

1.1.5 Time to Perform Task(s)

- 18. Using the [System Name] to [purpose of system] was fast enough for my needs.
- 75. I would feel comfortable using the [System Name] under time pressure.
- 81. Completing the task with the [System Name] is faster than current procedures.

1.1.6 System Response Time

- 12. The [System Name] responds quickly to the user's commands.
- 73. The [System Name's] response time is acceptable.

1.2 Product Quality

1.2.1 Quality of the Results (i.e., products)

- 17. Overall, the [System Name] provided me with useful results.
- 34. I found the [System Name's] results acceptable.
- 59. The [System Name] supports the preparation of high quality products.
- 76. The [System Name] would improve the quality of my work.

1.2.2 Overall Confidence

- 37. I have alot of confidence in the results obtained working with the [System Name].
- 46. I am confident that the [System Name] is well-built technically.
- 52. I have alot of confidence in the [System Name's] approach to [purpose of system].

1.2.3 Cost-Effectiveness

- 5. The [System Name] is cost-effective because the benefit of using it is worth the effort.
- 80. The [System Name] provides users alot of value for their efforts.

2.0 System Usability

2.1 General Ease of Use Questions

7. The displays are easy to read.
15. The displays are easy to understand.
35. It was easy to tell the [System Name] what to do.
55. The [System Name] is easy to use.
68. The [System Name's] input screens are easy to use.
71. The mouse and keyboard are easy to use.
[Note: The wording of this question depends on the type of input devices that the system uses.]

2.2 Quality of the User's Mental Model of the System

9. It was easy to form a mental picture of how the [System Name] works.
20. It was easy to understand why the results came out the way they did.
38. The organization of menu items is easy to understand.
56. It is clear what to do to get the [System Name] to perform the actions one wants.
62. The labels on the menu choices correctly describe the choice.
67. I understand how to use the [System Name] to do [purpose of system].
95. The system contains familiar terms.

2.3 Ease of Training

2.3.1 Learnability

26. The [System Name] requires no retraining for infrequent users.
53. One can learn to use the [System Name] in one two-hour training session.
77. The [System Name] was easy to learn.

2.3.2 On-Line Help Function

3. The [System Name] has sufficient help features.
70. The [System Name's] help features are easy to use.

2.3.3 Documentation - Not used for AA Comparator, but the standard form of the questions is presented below.

- How to use [System Name] is well documented.
- The [System Name's] User's Manual is easy to understand.

2.4 Human Factors Guidelines for Person-Machine Interaction

2.4.1 Consistency

25. The [System Name] uses the same layout for all screens.
48. The [System Name] presents similar information at the same place on the screen.
63. The same commands produce the same actions throughout the [System Name].

2.4.2 Error Prevention and Handling

16. The [System Name] helps to prevent errors the user might make when using it.
40. The [System Name] provides immediate error notification.
64. The [System Name] is designed so that it is easy to recover from errors, if they should occur when using it.

2.4.3 System Navigation

41. It is always clear where the user is in the [System Name].
54. The user can easily move from one menu item to another without errors in the [System Name].
72. The user can easily move to different parts of the [System Name] as required to do the tasks.

2.4.4 Use of Color

29. The [System Name] uses color in an intuitive way.
78. I understand the meaning of the different colors used in the displays.

2.4.5 Ease of Data Entry

30. I can easily supply the information the [System Name] asks me for.
50. It is easy to enter data into the [System Name].

2.4.6 Feedback

23. The [System Name] provides feedback when it's processing user commands.
60. The [System Name] provides the user with effective directions so that one always knows what to do next.

2.4.7 Reliability - Not used for AA Comparator, but the standard form of the questions is presented below.

- The number of system failures is acceptable.
- The level of down time is acceptable.
- The same inputs produce the same results.

2.5 Workload

2.5.1 Strain (i.e., effort)

6. The user does not have to exert much mental effort to use the [System Name] to compare avenues of approach.
45. The [System Name] reduces the amount of work required to compare avenues of approach.
74. The amount of effort required to use the [System Name] is acceptable.

2.5.2 Memorization

28. The user does not have to memorize commands to use the [System Name].
92. All necessary information is available on each screen.

2.6 Flexibility (Discretion and User Control)

21. I felt in control of the [System Name] when it was operated.
69. The system allows for adaptation to different scenarios.
96. The [System Name] permits the user to control the order in which different activities are done.

2.7 Functional Allocation Between Person and Machine

22. The [System Name] supports those tasks requiring support when [purpose of system].
88. The [System Name] is designed so that the right activities are allocated to the person and machine.
94. The [System Name] provides me with the right kind of support for [purpose of system].

4.0 How Well the System Fits In

4.1 Fit (i.e., Match) With User

4.1.1 Match With Users' Needs

43. The [System Name] meets my needs for [purpose of system].
47. The [System Name's] products meet my needs.
79. It is easier to [purpose of system] using the [System Name] than with my current procedures.

4.1.2 Match With Users' Training

8. The [System Name] is designed to match the computer skills of Army personnel who would use it.
84. The system's approach to comparing avenues of approach matches how I was trained to perform this task.

4.1.3 Match With Users' Problem-Solving Approach

31. The [System Name] performs [purpose of system] the way I do.

39. The [System Name's] approach to [purpose of system] matches my idea of how this task should be done.

91. In general, the [System Name] uses the same information that I use.

4.2 Fit (i.e., Match) With Organization

4.2.1 Match With Doctrine

13. The procedures used in the [System Name] are consistent with Army doctrine.

57. The procedures used in [System Name] follow Army doctrine.

4.2.2 Organizational Fit

1. The [System Name] fits well in the [organizational place for the system].

87. From a [organizational place for the system] perspective, the [System Name] is a good fit.

4.2.3 Effect on Information Flow

2. The [System Name] will facilitate the flow of information in the [organizational place for the system].

89. The [System Name] will not interfere with the flow of information in the [organizational place for the system].

4.2.4 Effect on Other People's Workload

27. The [System Name] would not increase the amount of work for other people involved in [purpose of system].

93. The [System Name] will decrease the workload of other people in the [organizational place for the system].

4.2.5 Attitude of Others (Political Acceptability)

4. Other people in the [organizational place for the system] will support the [System Name's] implementation.

66. My superiors would strongly favor the using the [System Name].

APPENDIX B
EXAMPLE STUDENT QUESTIONNAIRE

SPECC (Space Enhanced Command and Control Capabilities)

SPECC is a decision aid that supports automated worldwide unit location functions. It provides:

- Worldwide Automated Unit Locations
- Timing Synchronization (Worldwide Atomic Clock)
- Multi Map Display
- Worldwide Asset Tracking (GPS & Tracker)
- Worldwide Interconnectivity (Satellite Communications)
- Intelligence Broadcast Reception (National Asset Downlink)
- Situational Awareness (Red and Blue Force Status)
- OPORD Generation/Transmission
- Synchronization Matrices
- Unit, Log, Personnel and Status Reports
- Joint Forces C2 Applicability
- Other C2 Activities (Unit Status, Task Org., Graphics)

Staff members are aided in performing: Mission analysis, Intelligence Preparation of the Battlefield (IPB) and other Intelligence Functions, COA analysis and comparison, and execution tasks.

The purpose of this questionnaire is to obtain your opinion of SPECC. You will be given a number of statements about SPECC. Each statement will be followed by a scale and a section for comments. On the opinion scale, please indicate the extent to which you agree or disagree with each statement by circling the appropriate number on the 7 point scale. Use the comment section to explain your agreement or to make comments about the system. If an item is not applicable, or if you cannot answer the question, circle DK (Don't Know) at the end of the ratings.

The following information is requested in order to better interpret and analyze responses. All individual information will be treated as confidential and will not be released to third parties. If you have already completed one survey for another system just enter your name. Please answer the questions that apply to you.

NAME _____	RANK _____	BRANCH _____
ORGANIZATION (for data collectors only) _____		
DUTY POSITIONS WHILE USING SPECC		
DUTY POSITION LOCATION (circle): FORWARD	INTEL CELL	REAR
Approximate number of hours experience with this aid		
Did you actually operate the aid, just observe its use, or direct its operation by an operator (circle): OPERATE OBSERVE DIRECT		
PLEASE RETURN BY 27 MAY 94		

	<i>Strongly Disagree</i>	<i>Neither Agree Nor Disagree</i>	<i>Strongly Agree</i>	<i>Don't Know</i>
1. Overall, use of the SPECC will improve planning and execution performance.	1	2	3	4
Comments:	5	6	7	DK
2. The system uses the right information in producing its results.	1	2	3	4
Comments:	5	6	7	DK
3. SPECC responds quickly enough to user's commands.	1	2	3	4
Comments:	5	6	7	DK
4. The system would improve the quality of my work.	1	2	3	4
Comments:	5	6	7	DK
5. I have a lot of confidence in the results obtained working with SPECC.	1	2	3	4
Comments:	5	6	7	DK
6. The system's products meet my needs.	1	2	3	4
Comments:	5	6	7	DK
7. In general, SPECC uses the same information I would use in performing planning and execution tasks.	1	2	3	4
Comments:	5	6	7	DK

	<i>Strongly Disagree</i>	<i>Neither Agree Nor Disagree</i>	<i>Strongly Agree</i>	<i>Don't Know</i>
8. The terminology used by the system is consistent with Army doctrine.	1	2	3	4
Comments:	5	6	7	DK
9. SPECC would fit well into staff operations.	1	2	3	4
Comments:	5	6	7	DK
10. The system will facilitate the flow of information during planning and execution.	1	2	3	4
Comments:	5	6	7	DK
11. SPECC will decrease the workload for other staff officers.	1	2	3	4
Comments:	5	6	7	DK
12. Other staff officers will support the use of the system.	1	2	3	4
Comments:	5	6	7	DK
13. I feel I would be in control of SPECC while using it.	1	2	3	4
Comments:	5	6	7	DK
14. I can easily supply the information the system asks me for.	1	2	3	4
Comments:	5	6	7	DK

	<i>Strongly Disagree</i>	<i>Neither Agree Nor Disagree</i>	<i>Agree</i>	<i>Strongly Agree</i>	<i>Don't Know</i>			
	1	2	3	4	5	6	7	DK
15. The system provides the user with effective directions so that he knows what to do next.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Comments:								
16. To what extent would the following SPECC capabilities improve planning and execution performance?								
Worldwide Automated Unit Locations.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Timing Synchronization (Worldwide Atomic Clock).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Multi Map Display.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Worldwide Asset Tracking (GPS & Tracker).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Worldwide Interconnectivity (Satellite Communications).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Intelligence Broadcast Reception (National Asset Downlink).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Situational Awareness (Red & Blue Force Status).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
OPORD Generation/Transmission.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Synchronization Matrices.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Unit/Log/Personnel Status.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Joint Forces C2 Applicability.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other C2 Activities (Unit Status, Task Org, Graphics).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<i>Not At All</i>	<i>Some What</i>	<i>Very Much</i>					

17. To what extent would SPECC support the following tasks?

	Not At All	Some What	Very Much
Mission Analysis.....
IPB.....
COA Development.....
COA Analysis and Comparison.....
Commanders Decision.....
Execution.....

18. To what extent will SPECC support each of the following BOSS?

Maneuver.....	.....
Fire Support.....	.....
IEW.....	.....
Air Defense.....	.....
Mobility/Countermobility.....	.....
C2.....	.....
CSS.....	.....

19. Other comments (e.g., limitations, advantages, disadvantages, suggested additions and modifications).

APPENDIX C
EXAMPLE DATA COLLECTOR QUESTIONNAIRE

SPECC (Space Enhanced Command and Control Capabilities)

SPECC is a decision aid that supports automated worldwide unit location functions. It provides:

- Worldwide Automated Unit Locations
- Timing Synchronization (Worldwide Atomic Clock)
- Multi Map Display
- Worldwide Asset Tracking (GPS & Tracker)
- Worldwide Interconnectivity (Satellite Communications)
- Intelligence Broadcast Reception (National Asset Database)
- Situational Awareness (Red and Blue Force Status)
- OPORD Generation/Transmission
- Synchronization Matrices
- Unit, Log, Personnel and Status Reports
- Joint Forces C2 Applicability
- Other C2 Activities (Unit Status, Task Org., Graphics)

Staff members are aided in performing: Mission analysis, Intelligence Preparation of the Battlefield (IPB) and other Intelligence Functions, COA analysis and comparison, and execution tasks.

The purpose of this questionnaire is to obtain your opinion of SPECC. You will be given a number of statements about SPECC. Each statement will be followed by a scale and a section for comments. On the opinion scale, please indicate the extent to which you agree or disagree with each statement by circling the appropriate number on the 7 point scale.

Below each question is a space for comments. Please use this space to explain your agreement or to make comments about the system. If an item is not applicable, or if you cannot answer the question, circle DK (Don't Know) at the end of the ratings.

The following information is requested in order to better interpret and analyze responses. All individual information will be treated as confidential and will not be released to third parties. Please complete the information as appropriate.

NAME _____	RANK _____	BRANCH _____		
ORGANIZATION (for data collectors only)				
DUTY POSITIONS WHILE USING SPECC				
DUTY POSITION LOCATION (circle):	<input type="checkbox"/> FORWARD	<input type="checkbox"/> INTEL CELL.	<input type="checkbox"/> REAR	<input type="checkbox"/> OTHER SUBORDINATE CELL (LIST)
Approximate number of hours experience with this aid				
Did you actually operate the aid, just observe its use, or direct its operation by an operator (circle):	<input type="checkbox"/> OPERATE	<input type="checkbox"/> OBSERVE	<input type="checkbox"/> DIRECT	
PLEASE RETURN BY 27 MAY 94. RETURN VIA DISTRIBUTION ENVELOPES TO: ARI (DR. RIEDELL).				

STATEMENT

	OPINION									
	Strongly Disagree	1	2	3	4	5	6	7	DK	Don't Know
1. Overall, use of SPECC will improve planning and execution performance.	Strongly Disagree									
Comments:										
2. The system uses the right information in producing its results.	Strongly Disagree									
Comments:										
3. The user can easily modify information already in SPECC, if necessary.	Strongly Disagree									
Comments:										
4. The calculations performed by the system are helpful.	Strongly Disagree									
Comments:										
5. SPECC responds quickly enough to user's commands.	Strongly Disagree									
Comments:										

STATEMENT

OPINION

6. The system would improve the quality of the user's work.

	Strongly Disagree							Neither Agree Nor Disagree							Strongly Agree							Don't Know			
	1	2	3	4	5	6	7																		
Comments:																									

7. Users would have a lot of confidence in the results obtained working with SPECC.

	Strongly Disagree							Neither Agree Nor Disagree							Strongly Agree							Don't Know			
	1	2	3	4	5	6	7																		
Comments:																									

8. It was easy to form a mental picture of how the system works.

	Strongly Disagree							Neither Agree Nor Disagree							Strongly Agree							Don't Know			
	1	2	3	4	5	6	7																		
Comments:																									

9. Users can easily supply the information the system asks for.

	Strongly Disagree							Neither Agree Nor Disagree							Strongly Agree							Don't Know			
	1	2	3	4	5	6	7																		
Comments:																									

10. The procedures used by the system are consistent with Army doctrine.

	Strongly Disagree							Neither Agree Nor Disagree							Strongly Agree							Don't Know			
	1	2	3	4	5	6	7																		
Comments:																									

STATEMENT

OPINION

STATEMENT	OPINION									
	Strongly Disagree	1	2	3	4	5	6	7	DK	
	Strongly Agree	Neither Agree Nor Disagree	Strongly Agree	Neither Agree Nor Disagree	Strongly Agree	Neither Agree Nor Disagree	Strongly Agree	Neither Agree Nor Disagree	Strongly Agree	Don't Know
11. SPECC would fit well into staff operations.										
Comments:										
12. The system will facilitate the flow of information during planning and execution.										
Comments:										
13. SPECC will decrease the workload for staff officers.										
Comments:										
14. Staff officers will support the use of the system.										
Comments:										
15. Users would feel in control of SPECC while using it.										
Comments:										

STATEMENT

	OPINION									
	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree	Don't Know
Comments:										
16. It is easy to recover from errors made while using the system.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree	Don't Know
Comments:										
17. It is always clear to the user where he is in SPECC.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree	Don't Know
Comments:										
18. In general, SPECC provides information users would use in performing planning and execution tasks.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree	Don't Know
Comments:										
19. SPECC provides the user with effective directions so that he knows what to do next.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree	Don't Know
Comments:										
20. It is clear how to get the system to perform the actions one wants.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree	Don't Know
Comments:										

STATEMENT

OPINION

	OPINION									
	Strongly Disagree	1	2	3	4	5	6	7	DK	Don't Know
Comments:										
21. Planning and execution tasks can be completed faster using the system than not using SPECC.	Strongly Disagree	1	2	3	4	5	6	7	DK	Don't Know
Comments:										
22. The system's products meet users' needs.	Strongly Disagree	1	2	3	4	5	6	7	DK	Don't Know
Comments:										
23. Overall, SPECC is a valuable tool for tactical planning and execution.	Strongly Disagree	1	2	3	4	5	6	7	DK	Don't Know
Comments:										
24. The system provides users with useful results.	Strongly Disagree	1	2	3	4	5	6	7	DK	Don't Know
Comments:										
25. Users have a lot of confidence in SPECC's approach to planning.	Strongly Disagree	1	2	3	4	5	6	7	DK	Don't Know
Comments:										

STATEMENT

OPINION

	OPINION									
	Strongly Disagree	1	2	3	4	5	6	7	DK	Don't Know
26. The terminology used by the system is consistent with Army doctrine.										
Comments:										
27. The system permits the user to control the order in which different tasks are done.	Strongly Disagree	1	2	3	4	5	6	7	DK	Don't Know
Comments:										
28. The user can easily move to different parts of the system as required to perform the tasks.	Strongly Disagree	1	2	3	4	5	6	7	DK	Don't Know
Comments:										
29. Users would feel comfortable using the system under time pressure.	Strongly Disagree	1	2	3	4	5	6	7	DK	Don't Know
Comments:										
30. The organization of the menus is easy to understand.	Strongly Disagree	1	2	3	4	5	6	7	DK	Don't Know
Comments:										

STATEMENT**OPINION**

STATEMENT	OPINION									
	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree	Don't Know
31. SPECC will not interfere with the flow of information in the plans shop.										
Comments:										
32. The commander would strongly support using SPECC during planning and operations.										
Comments:										
33. It is easy to enter data into SPECC.										
Comments:										

Please circle the appropriate response.

34. How well would SPECC meet users' needs during an actual exercise?

Not At All	Some What	Very Much
1	2	3
		4
		5

35. To include SPECC in staff operations would be:

Very Difficult	Moderately Difficult	No Problem	Moderately Easy	Very Easy
1	2	3	4	5

36. How much would use of SPECC improve the quality of users' work?

Not At All	Some What	Very Much
1	2	3
		4
		5

37. To what extent would use of SPECC improve performance on the following tasks? Listed are general tasks and selected specific tasks.

37. (Continued)

To what extent would use of SPECC improve performance on the following tasks? Listed are general tasks and selected specific tasks.

	Not At All	Some What	Very Much	Don't Know
Execute Plan.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Increase situational awareness.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Track flow of key events.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Develop shared understanding of battlefield.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Synchronize tactical operations.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Direct and lead subordinate troops.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Control battle tempo.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lateral coordination.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Command on the move.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Track flow of key events.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

38. This section examines the ability of specific SPECC capabilities to:
- (1) increase situational awareness,
 - (2) facilitate a shared understanding of the battlefield,
 - (3) assist in the synchronization of tactical operations, including lateral coordination, and
 - (4) facilitate plan rehearsal.

For each capability below please:

- (1) rate the potential of this type of capability to improve performance on each of the 4 tasks,
- (2) rate how much current SPECC improves performance compared to unaided performance,
- (3) describe changes that should be made to SPECC's capabilities to improve it.

Put a number in each blank using the following scale.

No Improvement	Slight Improvement	Improvement	Much Improvement	Very Much Improvement	Not Applicable
1	2	3	4	5	NA

SPECC CAPABILITY	DEVELOP SIT. AWARENESS	SYNCHRONIZE TACTICAL OPS	DEV. SHARED UNDERSTANDING OF BATTLEFIELD	REHEARSE PLAN
Intelligence Broadcast reception (National Asset Downlink)				
Potential SPECC	—	—	—	—
Changes to SPECC?	—	—	—	—
Red and Blue Force Status				
Potential SPECC	—	—	—	—
Changes to SPECC?	—	—	—	—
Multimap display				
Potential SPECC	—	—	—	—
Changes to SPECC?	—	—	—	—
Worldwide asset tracking				
Potential SPECC	—	—	—	—
Changes to SPECC?	—	—	—	—
OPORD Generation/Transmission				
Potential SPECC	—	—	—	—
Changes to SPECC?	—	—	—	—

38. (Continued)

For each capability below please:

- (1) rate the potential of this type of capability to improve performance on each of the 4 tasks,
 - (2) rate how much current SPECC improves performance compared to unaided performance.
 - (3) describe changes that should be made to SPECC's capabilities to improve it.
- Put a number in each blank using the following scale.

No Improvement	Slight Improvement	Improvement	Much Improvement	Very Much Improvement	Not Applicable
1	2	3	4	5	NA

SPECC CAPABILITY	DEVELOP ST. AWARENESS	SYNCHRONIZE TACTICAL OPS	DEV. SHARED UNDERSTANDING OF BATTLEFIELD	REHEARSE PLAN
------------------	-----------------------	--------------------------	--	---------------

Synchronization Matrices

Potential _____
SPECC _____
Changes to SPECC? _____

Unit/Log/Personnel Status

Potential _____
SPECC _____
Changes to SPECC? _____

Joint Forces C2 Applicability

Potential _____
SPECC _____
Changes to SPECC? _____

Other C2 features (Unit Status, Task Org., Graphics)

Potential _____
SPECC _____
Changes to SPECC? _____

Worldwide automated unit locations

Potential _____
SPECC _____
Changes to SPECC? _____

38. (Continued)

For each capability below please:

- (1) rate the potential of this type of capability to improve performance on each of the 4 tasks,
- (2) rate how much current SPECC improves performance compared to unaided performance.
- (3) describe changes that should be made to SPECC's capabilities to improve it.

Put a number in each blank using the following scale.

No Improvement	Slight Improvement	Improvement	Much Improvement	Very Much Improvement	Not Applicable
1	2	3	4	5	NA

SPECC CAPABILITY	DEVELOP SIT. AWARENESS	SYNCHRONIZE TACTICAL OPS	DEV. SHARED UNDERSTANDING OF BATTLEFIELD	REHEARSE PLAN
------------------	------------------------	--------------------------	--	---------------

Timing Synchronization (Worldwide Atomic Clock)

Potential	—	—	—	—
SPECC	—	—	—	—
Changes to SPECC?	_____	_____	_____	_____

Worldwide Interconnectivity (Satellite Communications)

Potential	—	—	—	—
SPECC	—	—	—	—
Changes to SPECC?	_____	_____	_____	_____

39. How much would use of SPECCC improve the quality of your work in the following areas?

	Not At All	Some What	Very Much
Non-combat evacuation.....
Arms control.....
Support to civil authorities.....
Disaster relief.....
Security assistance.....
Nation assistance
Counter-drug operations.....
Anti-terrorism.....
Peace keeping.....
Show of force.....
Insurgency/counterinsurgency.....
Attacks and raids.....

40. To what extent will SPECC support the following missions/operations?

	Not At All	Some What	Very Much
Non-combat evacuation
Arms control
Support to civil authorities
Disaster relief
Security assistance
Nation assistance
Counter-drug operations
Anti-terrorism
Peace keeping
Show of force
Insurgency/counterinsurgency
Attacks and raids

41. To what extent will SPECC support each of the following BOS?

Maneuver.....	.....
Fire Support.....	.....
IEW.....	.....
Air Defense.....	.....
Mobility/Countermobility.	.....
C2.....	.....
CSS.....	.....